

**Mail Stop ISSUE FEE**

PATENT

Attorney Docket No. MTI-31533

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant : DERRAA, Ammar  
Serial No. : 09/941,533  
Filing Date : August 29, 2001  
For : METHOD OF FORMING A CONDUCTIVE CONTACT  
Group Art Unit: 2823  
Examiner : FOURSON III, George R.  
Confirmation No.: 4578

**CERTIFICATION OF SUBMISSION**

I hereby certify that, on the date shown below, this correspondence is being transmitted via the Patent Electronic Filing System (EFS) addressed to Examiner FOURSON at the U.S. Patent and Trademark Office.

Date:

April 25, 2006

Patricia Pickens

**Mail Stop ISSUE FEE**

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

**RESPONSE TO NOTICE OF ALLOWABILITY**

Sir:

This is in response to the Notice of Allowability, mailed January 26, 2006, in the above-identified patent application.

The Notice of Allowability indicates that the allowed claims are 1-73 and 101-129.

*This is incorrect*—the allowed claims should read as 1-39, 41-54, 56-73, and 101-129.

Claims 40 and 55 were canceled by Applicant in a Supplemental Response filed May 3, 2005, as a submission in a Request for Continued Examination (RCE).

Enclosed herewith is a copy of the following documents:

- Notice of Allowability indicating the requested correction;
- RCE transmittal (dated May 3, 2005); and
- Supplemental Response – pages 1, 8, 10, 26 (showing Claims 40 and 55 as having been canceled).

Correction of the Notice of Allowability is requested.

The Examiner is requested to contact the undersigned Attorney for Applicant if any question should arise.

Respectfully submitted,

  
Kristine M. Strodthoff  
Reg. No. 34,259

Dated: April 25, 2006

WHYTE HIRSCHBOECK DUDEK S.C.  
555 East Wells Street  
Suite 1900  
Milwaukee, Wisconsin 53202-3819  
(414) 273-2100

Customer No. 31870

# Notice of Allowability

Application No.

09/941,533

Examiner

George Foursoun

Applicant(s)

DERRAA, AMMAR

Art Unit

2823

**- The MAILING DATE of this communication appears on the cover sheet with the correspondence address-**

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment file 11/14/05.
2. ☒ The allowed claim(s) is/are 1-73 and 101-129 *← should be 1-39, 41-54, 56-73, 101-129*
3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some\* c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\* Certified copies not received: \_\_\_\_\_

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.  
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

4. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ Including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date \_\_\_\_\_
- (b) ☐ Including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date \_\_\_\_\_
- (identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).)
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

## Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08),  
Paper No./Mail Date 1/28/02
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material

5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413),  
Paper No./Mail Date \_\_\_\_\_
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other \_\_\_\_\_

*George Foursoun*  
George Foursoun  
Primary Examiner  
Art Unit: 2823

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PTO/SB/50 (04-05)

Approved for use through 5/31/2006. OMB 0501-0031

U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE

Under the Trademark Extension Act of 1996, no requests are required to respond to a selection of information under Section 1.114 of the USPTO Manual.

Request  
for  
Continued Examination (RCE)  
Transmittal

Address to:  
Mail Stop RCE  
Commissioner for Patents  
P.O. Box 1460  
Alexandria, VA 22313-1450

Application Number	09/041,533
Filing Date	09/29/2001
First Named Inventor	Amoral Darnas
Art Unit	2823
Examiner Name	George R. Fournon II
Attorney Docket Number	MTI-31533

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application. Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs that is submitted to the USPTO on page 2.

1. **Submission required under 37 CFR 1.114** How: If the RCE is proper, any previously filed unexamined amendments and amendments entered with the RCE will be entered in the order in which they were filed unless applicant indicates otherwise. If applicant does not wish to have any previously filed unexamined amendments entered, applicant must request non-entry of such amendments(s).
  - a. ☒ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.
    - i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on \_\_\_\_\_
    - ii. ☐ Other \_\_\_\_\_
  - b. ☒ Enclosed
    - i. ☐ Amendment/Reply
    - ii. ☐ Affidavit Declaration(s)
    - iii. ☐ Information Disclosure Statement (IDS)
    - iv. ☒ Other Supplemental Response
2. **Miscellaneous**
  - a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(e) for a period of \_\_\_\_\_ month(s). (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.103(e) required)
  - b. ☐ Other \_\_\_\_\_
3. **Fees** The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed. The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to deposit Account No. 23-2053. I have enclosed a duplicate copy of this sheet.
  - a. ☒ RCE fee required under 37 CFR 1.17(e)
  - b. ☐ Extension of time fee (37 CFR 1.136 and 1.37)
  - c. ☐ Other \_\_\_\_\_
  - d. ☐ Check in the amount of \$ \_\_\_\_\_ enclosed
  - e. ☐ Payment by credit card (Form PTO-5036 enclosed)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-5036.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED		Date
Signature	Kristine A. Stradhoff	MAY 3, 2005
Name (Print/Type)	Kristine A. Stradhoff	Registration No. 34259

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being transmitted with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Mail Stop RCE, Commissioner for Patents, P.O. Box 1460, Alexandria, VA 22313-1450 or by other means as directed by the U.S. Patent and Trademark Office on the date shown below.

Signature	Paul L. Hill	Date	5-3-05
Name (Print/Type)	PAUL L. HILL		

This extension of information is required by 37 CFR 1.114. This information is required to obtain a notice of receipt by the public which is to be filed by the USPTO in patent or application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This extension is calculated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, please go to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1460, Alexandria, VA 22313-1450. DO NOT SEND FEE OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1460, Alexandria, VA 22313-1450.

If you need assistance in completing this form, call 1-800-PTO-9199 and select option 2.

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PATENT

Attorney Docket No. MTI-31533

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : DERRAA, Ammar  
Serial No. : 09/941,533  
Filing Date : August 29, 2001  
For : METHOD OF FORMING A CONDUCTIVE CONTACT  
Group Art Unit: 2823  
Examiner : FOURSON III, George R.  
Confirmation No.: 4578

## CERTIFICATION UNDER 37 CFR 1.8(a) and 1.10

I hereby certify that, on the date shown below, this correspondence is being transmitted to Fax No. 703-872-9306 addressed to Examiner FOURSON at the US Patent and Trademark Office.

Date: May 3, 2005 Jim R. Houk

Mail Stop RCE

Commissioner for Patents

P.O. Box 1450

Alexandria, VA 22313-1450

SUPPLEMENTAL RESPONSE

Sir:

Applicant requests consideration of the pending claims in the above-identified patent application based on the remarks herein.

Amendments to the Claims are reflected in the listing of the claims, which begins on page 2 of this paper.

Remarks begin on page 2 of this paper.

USPN 09/941,533

Supplemental Response

39. (original) The method of Claim 38, wherein the source gas further comprises a borane precursor to form a boron-doped titanium nitride contact.

→ 40. (canceled)

41. (original) The method of Claim 33, wherein the step of subjecting the contact to a heat treatment reduces the chlorine concentration of the contact by at least about 75% by wt.

42. (original) The method of Claim 33, wherein the step of subjecting the contact to a heat treatment reduces the chlorine concentration of the contact by at least about 95% by wt.

43. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 1% by wt.

44. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 3% by wt.

45. (original) The method of Claim 33, wherein the chlorine concentration of the heat treated conductive contact is less than about 4% by wt.

46. (currently amended) A method of forming a contact, comprising:  
depositing a first source gas comprising  $\text{TiCl}_4$ ,  $\text{H}_2$ , and  $\text{SiH}_4$  precursors onto a substrate to form a titanium silicide layer in an opening;  
depositing a second source gas comprising  $\text{TiCl}_4$  and  $\text{NH}_3$  precursors onto the titanium silicide layer to form a titanium nitride layer;  
removing excess of the titanium nitride layer by chemical mechanical polishing while maintaining the titanium nitride layer within the opening to form the contact; the contact having a concentration of chlorine and a thickness of at least about 500 angstroms; and

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Supplemental Response

52. (currently amended) A method of forming a conductive contact in a semiconductor device comprising an opening through an insulative layer, the opening having sidewalls and extending to an underlying silicon-comprising substrate, the method comprising the steps of:

forming a layer comprising titanium silicide over the insulative layer and the substrate within the opening;

depositing a layer of boron-doped titanium nitride over the titanium silicide layer from a titanium and chlorine-containing precursor to fill the opening;

removing excess of the boron-doped titanium nitride layer overlying the insulative layer while leaving the boron-doped titanium nitride layer within the opening to form the contact having a thickness of at least about 500 angstroms; and

heat treating the contact at a temperature of about 700°C. or greater to remove chlorine from the contact without forming substantial cracks therein.

53. (original) The method of Claim 52, wherein the opening has an aspect ratio of about 3:1 or greater.

54. (original) The method of Claim 52, wherein the opening is about 0.25  $\mu\text{m}$  or less.

→ 55. (canceled)

56. (original) The method of Claim 52, wherein the conductive contact has a thickness of about 1000 to about 3000 angstroms.

57. (original) The method of Claim 52, wherein the step of depositing the boron-doped titanium nitride layer is by thermal chemical vapor deposition using a gaseous mixture comprising titanium tetrachloride, ammonia, and diborane.

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## Supplemental Response

Remarks

Reconsideration of pending Claims 1-73 and 101-129 is respectfully requested.

Claims 1, 11, 16, 22, 26, 30, 33, 46, 50, 52, 62, 66-73, 101-110, 112-114, 116-117, 119-124, and 127-129 have been amended. Claims 40 and 55 have been cancelled. ←

The claims have been amended to more clearly recite the features of forming the conductive contact. The claims as amended recite that the heat step (700°C or greater) is performed on a contact having a thickness of about 500 angstroms or greater, and results in a reduction of chlorine<sup>1</sup> and a contact without substantial cracks.

Support for the amendments to the claims is in the specification at page 14, line 4 ("...particularly when the thickness of the contact reaches about 500 angstroms or greater...), at page 3, lines 21-23 ("...It has also been found that conducting a CMP process to remove excess material from the substrate prior to the anneal step avoids undesirable problems with cracking of the film layer and the wafer substrate....), page 6, lines 7-10 ("...The present method provides a process of removing undesirable components such as chlorine and the like, from a contact which overcomes problems in the art with cracking from anneal processing steps...), and page 14, lines 9-12 ("...In addition, conducting the thermal anneal step after removing excess conductive material from the surface of the substrate eliminates problems encountered with cracking of the film layer and/or the substrate with thermal anneals performed on a blanket material layer overlying the substrate.).

No new matter is added with these amendments to the claims, which are intended to merely clarify language used in the claims and/or the subject matter claimed. The scope of the claims is intended to be the same after the amendment as it was before the amendment.

Rejections under 35 U.S.C. § 103(a)

The Examiner maintains the rejection of Claims 1, 2, 3-9, 11-14, 16-19, 21-24, 26-28, 30, 31, 34, 35, 37, 38, 40-45, 49, 68, 71, 101-105, 112, 114, 116, 120, and 121 as obvious over Wang (US 2002/0155219) in view of Hu (USP 6,436,820). This rejection is respectfully traversed.

<sup>1</sup> Claim 1 recites "a component."